SECTION 16100 — BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SCOPE:

A. The work covered under this section of the specifications shall include the furnishing and installation of the devices, material and associated hardware as specified and/or indicated with all necessary electrical connections for complete installation of all systems.

1.3 QUALITY ASSURANCE:

A. All devices, material, hardware and installation shall be in accordance with the requirements of the local electrical code and the National Electrical Code (NEC).

B. All devices and material shall be as listed by Underwriters' Laboratory and shall bear the U.L. Label.

C. All new devices and equipment shall be AYear 2000 Certified.

PART 2 - PRODUCTS

2.1 CONDUIT:

A. Material shall be new and full length as follows:
   1. Branch circuits to be galvanized rigid steel conduit or Intermediate metal conduit (IMC) underground and in concrete slab, electric metallic tubing elsewhere.
   2. Motor connections of short lengths at least 18" long, galvanized single strip flexible conduit, Greenfield.
   3. Motor feeders 5 horsepower and over to be galvanized rigid steel conduit or intermediate metal conduit (IMC) underground, electric metallic tubing elsewhere.
   4. Panel feeders to be galvanized rigid steel conduit or intermediate metal conduit (IMC) underground, electric metallic tubing elsewhere.
   5. Telephone, control, fire alarm and all other auxiliary systems to be galvanized rigid steel conduit or IMC underground and in all concrete floor slabs, electric metallic tubing elsewhere.
   6. Union, couplings, and fittings for rigid conduit shall be of galvanized steel of conventional dimensions and shall be internally threaded at each end to fit the tapered thread standard for the corresponding size conduit. Couplings and fittings for electric

metallic tubing shall be of steel and shall be of the compression or setscrew type. (Cast pot metal and crimp type are not acceptable).

7. Install seal-off fittings in conduits entering hazardous areas and conduits entering cold temperature areas, such as freezers and refrigerators.
8. Acceptable manufacturers are Allied, Republic, Triangle or Wheatland.

B. All conduits run within the building construction shall be concealed except in electrical and mechanical equipment rooms or as otherwise indicated and or noted on the drawings. Conduit shall run parallel and perpendicular to building walls. Conduit shall be minimum 1/2". 1/2" flexible metal conduit may be used for lay-in light fixture connections (see Section 16500), or as specifically indicated on drawings. All runs in walls and partitions to be vertical not horizontal or diagonal. Conduit runs in concrete slabs shall be only as approved by the Architect and shall be limited to 3/4" conduit.

C. Emergency Circuit/Systems Identification:
1. All boxes, panels and enclosures including conduit (every 20'-0") for emergency circuits and systems shall be permanently marked so that they will be readily identified as a component of an emergency circuit or system.
2. Manufacturer's standard, bright-color, spray enamel paint.
3. Color code for emergency circuits and systems shall be as follows:

Life Safety Branch	Yellow
Critical Branch	Orange
Equipment Branch	Green
Fire Alarm	Red

2.2 SUPPORTING DEVICES AND HANGERS:

A. Provide a system of supporting devices and hangers for support or bracing of conduit, electrical equipment; including safety switches, fixtures, panelboards, outlet boxes, junction boxes, and cabinets.

B. Acceptable manufacturers are Erico Products, Inc., Steel City, Minerallac, and Rayco Fasteners.

C. Provide appropriate supporting devices and hangers for electrical equipment from this list of Caddy fasteners:
1. "Z" purline clips.
2. Conduit clips.
3. Beam clamps (universal and vertical flange).
4. Beam clamps (set screw type).
5. Combination push-in conduit clips.
6. Combination conduit hanger clamps.
7. Flexible conduit clips.
8. Special combination conduit clips.
9. One hole steel straps.

D. Installation Requirements:

1. Secure conduits to within 3 feet of each outlet box, junction box, cabinet and fitting and at intervals not to exceed 10 feet in accordance with current edition of the National Electrical Code.
2. Install clamps secured to structure for feeder and other conduits routed against the structure. Use drop rods and hangers to top of structural member to support conduits run apart from the structure.
3. Provide and install suitable angle iron, channel iron or steel metal framing with accessories to support or brace electrical equipment including safety switches, fixtures and panelboards.
4. Paint all supporting metal not otherwise protected, with rust inhibiting primer and then with a finish coat if appropriate to match the surrounding metal surfaces. (Prepainted or galvanized support material is not required to be painted or repainted).
5. Use of chains, perforated iron, baling wire, or tie wire for supporting conduit runs will not be permitted. Use of caddy clips to support conduit to top of t-bar ceiling grid or ceiling grid hanger wire will not be permitted.

2.3 WIRE AND CABLE:

A. Material shall be new copper conductors and as follows:
1. Branch feeders #8 AWG and smaller shall be solid and THHN or THWN 600 volt. Minimum wire size shall be #12 unless noted or specified otherwise.
2. Branch feeders #6 AWG and larger shall be THWN or THHN 600 volt.
3. Panel feeders shall be THWN or THW 600 volt.

B. All wiring throughout building shall be color coded to identify phases, neutral and ground. Color code shall be in accordance with NEC and as follows unless local Electrical Inspector requires special color-coding.

	SYSTEM VOLTAGE	
CONDUCTORS	**120/208**	**277/480**
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	White
Ground	Green	Green

C. Installation of 600 volt conductors:
1. Conductors shall be continuous between outlets or junction boxes and no splices shall be made except in outlet boxes and panelboard gutters.
2. All joints, splices and taps #10 and smaller connected with T & B PT connectors, #8 and larger connected with solderless split bolt type pressure connectors.
3. Oil or grease shall not be used when pulling conductors. Approved cable-pulling lubricants only.
4. Train conductors neatly in panels, cabinets, and equipment.
5. Tighten pressure type lugs on panels and equipment, and then retighten 24 hours later, or to manufacturer's recommended torque.

D. Identification of Conductors:
   1. All branch circuits shall be left tagged in the panelboards, in all gutters, and in all junction boxes where unused circuits terminate for the purpose of identifying the various circuits.
   2. Feeders and mains shall be tagged in the main distribution panelboard.
   3. The method of tagging shall be with adhesive type of marker. Tags shall be applied after wire is installed in conduit.
   4. Where it is impractical to use printed markers on certain wires or cables, use blank type with identification marked thereon in indelible pencil.

E. Conductors in vertical conduit runs shall be supported with split wedge type fittings, which clamp each conductor and automatically tighten under the weight of the conductors at intervals per NEC.

F. All wiring shall be installed in conduit unless indicated or specified otherwise.

G. Homeruns longer than 100 feet from the panel shall be not less than No. 10 AWG, copper.

H. Install #12 galvanized steel pull wire or 200 lb. test handline in all empty conduits.

I. AC cabling with insulated grounding conductor, may be used for lighting circuits only if approved by all local authorities having jurisdiction.

J. Type MC cable with insulated grounding conductor may be substituted for branch circuiting and feeders, up to a maximum of 60 amps per circuit, in lieu of conductors in conduit. Support cable every 6'-0" and within 12" of outlet and in accordance with the NEC. Cable must be supported in a neat and orderly manner.

K. Electric metal tubing shall be used for emergency and life safety loads.

L. Acceptable manufacturers are Anaconda, General Cable, Okonite, Rome, Triangle and Southwire.

2.4 HANGERS AND BRACKETS:

A. All conduits shall be supported from the building structure. Horizontal runs of conduit shall be supported a minimum of 8 feet on center. Hangers shall be adjustable type especially made for electric conduit. Conduit 3/4" and 1" in size, where run through steel bar joist construction shall be securely tied to the joist with a double strand of No. 18 galvanized tie wire. Parallel runs of conduit shall be supported on trapeze hangers made of 1/4" x 20 all thread rods with structural steel channel cross members. Channels shall be 1" for 24" wide trapeze and 1-1/2" for larger than 24". Perforated steel straphangers are not acceptable. Conduit run along wall surfaces shall be supported with galvanized steel brackets especially designed for conduit and sized for the conduit used. Conduit supported greater than 5'-0" from structure shall be supported securely to prevent all swaying.

2.5 WIREWAY:

A. Wireway shall be used as required for mounting groups of switches and/or starters. Wireways shall be the standard manufactured product of a company regularly producing wireway and shall not be a local shop assembled unit. Wireway shall be of the hinged cover type, UL listed, and of sizes indicated or as required by NEC, if not indicated. The opening, including connectors, shall be completely open without interference. Finish shall be ANSI 49 gray epoxy paint applied by an e-coat process UL listed for outdoor use. Wireway shall be Square D Square Duct or equal.

2.6 PULL AND JUNCTION BOXES:

A. Junction and pull boxes shall be provided where necessary for the installation of the electrical system. Junction or pull boxes not over 100 cubic inches in volume shall be constructed in accordance with requirements of NEC. All junction boxes must have covers and be accessible after completion of the building. Where several feeders pass thru a common pull box, the feeders shall be tagged to indicate clearly their electrical characteristics and circuit numbers and panel designation. Paint same information on cover of box.

B. Sheet steel pull boxes shall be provided only in dry protected locations and fabricated with required knockouts and removable screw cover. Finish with one coat of zinc chromate and a coat of primer sealer and paint to match surroundings.

C. Cast metal pull boxes shall be provided with gasketed screw cover drilled and tapped holes as required. Bolts shall be brass or bronze.

D. Pull boxes shall be provided in any conduit run which exceeds 75 feet in length or any run having more than a total of 270° in conduit bends.

E. Pull and junction boxes shall be identified with the appropriate panel circuit numbers.

F. For exterior work, provide galvanized sheet metal boxes of code thickness with lapped and welded joints, 3/4" flanges, bolted covers with full gaskets forming a completely raintight assembly, equal to Keystone 19000 Series.

G. For exterior work in graded areas outside the building, provide heavy-duty sidewalk junction boxes externally flanged for flush mounting. Covers shall be fully gasketed, watertight and secured with plated screws or bolts equal to Quazite Type PC.

2.7 OUTLET BOXES:

A. Boxes shall be steel, hot-dipped galvanized after fabrication, and shall have only the holes necessary to accommodate the conduits at point of installation. Sectionalized boxes shall be used wherever possible to group adjacent devices under a single plate as detailed on the drawings.

B. Ceiling outlet boxes for lighting fixtures where conduit is concealed shall be deep type, four-inch diameter, and have covers with center opening, 3" in diameter.

C. Outlet boxes for switches and receptacles in finished walls shall be of suitable size for the device to be mounted and the partitions in which they are installed. The boxes shall have covers

with rectangular openings of proper size and shape. Provide covers with raised openings on all outlets in masonry walls with plaster or tile finishes. Wall switch outlets shall be close to the trim on lock side of door. Outlet boxes shall be set flush with the wall and shall be rigidly supported between studs with adjustable bar hangers and one side of box must be affixed to a stud.

D. Single gang outlet boxes installed in concrete or masonry shall be minimum 3-1/2" deep, 4" long and 2" wide, set flush with all and provided with single gauge wall plate.

E. Outlet boxes for exposed switches and receptacles shall be of the FS 'condulet' type.

F. Outlet boxes for telephone outlets shall be 4" square and 2-1/8" deep. Note: Floor box size shall be adequate to contain an amphenol connector; exposed amphenol connector will not be acceptable.

G. Provide bushings in holes through which cords or conductors pass.

H. Acceptable manufacturers are National, Appleton, Raco and Steel City.

2.8 BUSHINGS AND LOCKNUTS:

A. Use OZ Type 'B' insulated or type 'BLG' bushing where necessary to bond conduit to ground connection. Bushings shall be as manufactured by OZ/ Gedney, T&B or Crouse-Hinds.

B. Locknuts shall be used on both sides of conduit connections to box or panel in addition to bushing. Where a larger size opening occurs than size of conduit, use reducing locknuts. Do not use reducing washers.

C. Bushings shall be provided for all conduits 1" and larger.

2.9 CABINETS:

A. Cabinets shall be fabricated of code gauge sheet steel with approved insulators, for flush or surface mounting of size indicated on drawings, complete with hinged lockable doors and index card holder. Flush mounted cabinets shall be finished shop prime and painted after installation to match surroundings. Surface mounted cabinets shall be finished gray baked enamel.

2.10 PANELBOARDS:

A. Panelboards shall have NEMA 1 general-purpose enclosures and shall be surface or recess mounted as noted. All panelboards shall be rated for the intended voltage and shall be in accordance with the Underwriter's Laboratories, Inc. "Standard for Panelboards" and "Standard for Cabinets and Boxes" and shall be so labeled where procedures exist. Panelboards shall also comply with NEMA Standard PBI for Panelboards and the National Electric Code. Circuit breakers shall conform to the paragraph, which follows in these Specifications.

B. Interiors: All interiors shall be completely factory assembled with switching and protective devices, wire connectors, etc. All wire connectors, except screw terminals, shall be of the anti-turn solderless type and all shall be suitable for copper wire of the sizes indicated.

C. Interiors shall be so designed that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus connectors and shall be so designed that circuits may be changed without matching, drilling or tapping.

D. Branch circuits shall be arranged using double row construction except where a narrow column panel is required. The manufacturer shall number branch circuits.

E. Contactors called for in panel schedule shall be mechanically held, electrically operated, ASCO, or as approved equal. Bulletin 920 contactors built into the panel and suitable for remote pushbuttons or automatic controls as indicated. Provide all pushbuttons and wiring.

F. Provide three 3/4" and two 1" empty conduits up thru wall and turned out above ceiling and three 3/4" and two 1" empty conduits down to space below floor for all flush mounted panels, except where floor slab is on grade, provide only conduits to ceiling.

G. All surface mounted panels shall be mounted on 12 gauge formed steel channel having a cross section dimension at least 1-1/2" x 1-1/2". The channel and fittings shall have galvcrom or hot dipped galvanized finish to resist rust formation. Channels shall be installed vertically. Provide blocking in wall as required.

H. A nameplate shall be provided listing panel type, number of protective and switching devices and ratings.

I. Bus bars for the mains shall be of copper sized in accordance with Underwriters' Laboratories Standards. Unless otherwise noted, full size neutral bars shall be included. Bus bar taps for panels with single pole branches shall be arranged for sequence phasing of the branch circuit devices. Bussing shall be braced throughout to conform to industry standard practice governing short circuit stresses in panelboards. Phase bussing shall be full height without reduction. Cross connectors shall be copper. Ground bus shall be provided for each panelboard (see "Grounding" for ground connections). Breakers connected to bus shall be bolt on.

J. Neutral bussing shall have a suitable lug for each outgoing feeder requiring a neutral connection. Neutral bus shall be insulated from panel box enclosure.

K. Boxes shall be made from unpainted galvanized code gauge steel having multiple knockouts except where noted. Boxes shall have gutter and wiring space sized as required, per NEC, but no less than 4" on all sides. Where feeder cables supplying the mains of a panel are carried through its box to supply other electrical equipment, the box shall be so sized as to include this wiring space. This wiring space shall be in addition to the minimum gutter space specified above and the limiting width may be increased accordingly.

L. At least four interior mounting studs shall be provided.

M. Box identification number shall be on the box.

N. Trim: Hinged doors covering all switching device handles shall be included in all panel trims, except that panelboards having individual metal clad externally operable deadfront units in spaces reserved for mechanical and electrical equipment, may be supplied without such doors.
   1. Doors in panelboards trims shall conform to the following:
      a. In making switching device handle accessible, doors shall not uncover any live parts.

b. Doors shall have semi-flush type cylinder lock and catch, except that doors over 48" in height shall have a vault handle and 3-point catch, complete with lock, arranged to fasten door at top, bottom, and center. Door hinges shall be concealed. Two keys shall be supplied and all locks shall be keyed as those installed by maintenance for retrofit. Directory frame and card, having a transparent cover, shall be furnished on each door. Directory cards shall be neatly typewritten indicating each branch circuit assignment.

2. The trims shall be fabricated from code gauge sheet steel.
3. All panelboard's steel surfaces, exterior and interior, shall be properly cleaned and finished with gray ANSI-61 paint over a rust-inhibiting phosphatized coating. The finish paint shall be of a type to which field applied paint will adhere.
4. Trims for flush panels shall overlap the box by at least 3/4" all around. Surface trims shall be mountable by a screwdriver without the need for special tools.

O. Panel indicated for provisions for future breakers shall have bus, mounting holes, and knockouts in front cover for future breakers.

P. Panelboards shall be as manufactured by Square D, Cutler-Hammer, or Siemens, and shall be of the same manufacturer as the safety switches.

Q. All panelboards serving Emergency shall be indicated Life Safety Branch, Critical Branch or Equipment Branch.

R. Surge Suppressors
1. The Contractor shall furnish and install where shown on the Drawings, panelboard transient voltage surge suppressors. The suppressors shall be 120/208 volt, three phase, U.L. listed, complete with NEMA Type 3R or 12 enclosure and mounted immediately adjacent to the panelboard with a 3/4" nipple. A surge suppressor, which meets this Specification, is EFI Electronics Corporation Model No. OSW 120/208 or Innovative Technology, Inc. Model No. P-3Y Plus.
2. The EFI model shall be connected to a dedicated three pole, 30 amps. branch circuit breaker in the associated panelboard as directed by the manufacturer. The Innovative Technology model shall be connected to 3 single poles, 20 amp. branch circuit breakers in the associated panelboard as directed by the manufacturer.
3. The suppressor shall have a minimum five-year warranty.

2.11 SWITCHES AND RECEPTACLES:

A. Lighting Switches:
1. Lighting switches shall be completely enclosed and the quiet operating type. Terminal screws on connectors shall be able to accommodate up to No. 10 solid conductors. Switches controlling lighting loads shall be rated at 20 amps. Where more than one switch is indicated at an outlet, they shall be installed under one plate in order to control the outlets indicated. Switches specified are that as manufactured by Pass & Seymour, specification grade, and ivory in color. Bryant, Hubbell and Leviton will be considered equal.

INTERIOR RECEPTACLES	**P&S**
20A, 1 Pole	20AC-1

20A, 3 Way	20AC-3

All switch devices controlling emergency lighting shall be a factory finished "red" devices. Contractor shall not install emergency power switches with normal power switches in the same outlet box. "Barriers" are not acceptable.

All key switches shall be P&S 20AC1-L Series supplied with two keys.

All dimmer switches shall be Lutron; Lutron Catalog #N-600 to N-2000. (Dimmer switches shall be rated as per load on switch.)

2. Provide red jeweled pilot light and key operation for switches as indicated.
3. Switchplates shall be furnished and installed at all light switch locations. Plates shall be 0.04 inch thick, Type 302, stainless steel with satin finish. Provide tamperproof screws. Switchplates for devices controlling emergency lighting shall also be engraved "Emergency" and letters filled with red enamel.
4. Switches shall be mounted vertically 4 ft. from center of outlet to floor, unless otherwise indicated. Notify Architect of discrepancies before roughing in outlet and obtain a new location.

B. Safety Switches:
1. Safety switches shall be horsepower rated, quick-make, quick-break type switches with spring reinforced wire grips and self-aligning switch contact. Switches shall be enclosed in a heavy sheet metal enclosure with hinged interlocking cover, which shall prevent the cover being opened when switch is 'on'. Mount all switches 60 amp and larger on 12 gauge formed steel channels having a cross section dimension at least 1-1/2" x 1-1/2". Switches shall be provided with proper mounting for Class J or L fuses and shall be NEMA Type HD, 250 volts A.C. or 600 volts A.C., as required by the voltage of the circuit on which they are utilized.
2. All switches shall be NEMA-1 Enclosures when indoors in normal dry locations and NEMA-3 when located outdoors or in damp locations.
3. The channel and fittings shall have galvcrom or hot dipped galvanized finish to resist rust formation, install channels vertically. Channels shall be Kindorf or equal.
4. Provide cartridge type fuses in switches as indicated. Fuses shall be Bussman Fusetron dual element fuses, or as noted per drawings.
5. Switches shall be as manufactured by Square D, Cutler-Hammer or Siemens and shall be of the same manufacturer as the panelboards.

C. Receptacles:
1. Receptacles shall be flush type, 15 amps, 125 volt, duplex unless designated as special purpose outlet. A single receptacle on a 20-amp circuit shall be rated at 20 amps. Receptacles shall be designed to accept standard two-wire parallel connector caps and shall rip both sides of the connector wire. All receptacles shall be grounding type specification grade throughout regardless of symbol shown on the drawings. Receptacles specified are that as manufactured by Pass & Seymour, specification grade, and ivory in color. Bryant, Hubbell and Leviton will be considered equal.

INTERIOR RECEPTACLES	**P&S**
15A, 125 Volt	5262-I
20A, 125 Volt	5362-I

All receptacle devices connected to emergency branch circuits shall be factory finished "red" devices. Contractor shall not install emergency power switches with normal power switches in the same junction box. "Barriers" are not acceptable.

2. Special 250V receptacles and 120V receptacles rated 30A or more shall be simplex outlets of rating, poles, and wires indicated of NEMA configuration, and shall be specification grade of the same manufacturer as the others. Provide a matching cap with each special receptacle installed.
3. Provide 0.04-inch thick satin finish, Type 302, stainless steel plates at all receptacle outlets not otherwise specified. Provide tamperproof screws. Outlet plates for devices connected to emergency circuits shall also be engraved "Emergency" and letters filled with red enamel.
4. Receptacles shall be mounted 18" center to finished floor, except receptacles at cabinets shall be mounted with centers 4" above top of backsplash of counter. Receptacles at water coolers shall be located behind the cooler as recommended by manufacturer of the cooler. Mount receptacles with long axis vertical, bond-grounding terminal to outlet box with #12 green conductor. Receptacles shall be installed with ground pin up.
5. Ground fault interrupter outlets shall be P&S 1591-FHGI. For exterior applications, provide a NEMA 3R box and cover.
6.

2.12 FUSES:

A. Fuses shall be listed and meet U.L. and/or NEMA Standards for Class RK5, J and L fuses.

B. Dual element cartridge fuses shall be Class K5, high interrupting capacity with current limiting effect, 200,000 ampere RMS symmetrical at rated voltage minimum, and a minimum time delay of 10 seconds at 500 percent load. Class K-5 fuses shall be used for individual motor circuit protection, for motor control centers and motor starter panel’s protection.

C. Class J and L fuses shall be provided for non-motor loads.

D. Fuses voltage rating shall be 250 volts for 120/208-volt systems and 480 or 600 volts for 277/480-volt systems.

E. Provide two complete sets of fuses for all switches requiring fuses, including switchboards, distribution panels, etc. One set of fuses shall be installed complete and the other stored in the original boxes in a cabinet in the main electrical room. Cabinet shall be furnished and installed by Contractor.

F. Fuses shall be as manufactured by Bussman Manufacturing Division of McGraw-Edison Company, The Chase-Shawmit Company, or Reliance.

G. Provide 'R' clips as required by N.E.C.

2.13 CIRCUIT BREAKERS:

A. Switch and fuse or molded case circuit breakers shall protect electrical circuits.

B. Each pole of these breakers shall provide inverse time delay and instantaneous circuit protection.

C. The breakers shall be operated by a toggle type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip free from the handle so that the contacts cannot be held closed against short circuits and abnormal currents. Tripping due to overload or short circuit shall be clearly indicated by the handle automatically assuming a position midway between the manual ON and OFF positions. All latch surfaces shall be ground and polished. All poles shall be so constructed that they can open, close and trip simultaneously.

D. Breakers must be completely enclosed in a molded case. Non-interchangeable trip breakers shall have their covers sealed; interchangeable trip breakers shall have the trip unit sealed to prevent tampering. Ampere ratings shall be clearly visible. Contacts shall be non-welding silver alloy. Arc extinction must be accomplished by means of arc chutes consisting of metal grids mounted in an insulating support. Breakers shall be of the bolt-on type; plug-in and plug-on, blow-on and clamp-on circuit breakers are not acceptable.

E. The minimum interrupting ratings of the circuit breakers shall be at least equal to or greater than the available short circuit at the line terminals.

F. Circuit breakers shall be listed with Underwriters' Laboratories Inc., (where procedures exist), conform to the applicable requirements of latest issue of NEMA Standards Publication No. ABI.

G. Molded case circuit breakers shall be of the following:
   1. Thermal magnetic standard that provides inverse time delay overload and instantaneous short circuit protection by means of a thermal magnetic element.
   2. Ambient compensating standard that provides inverse time delay overload and instantaneous short circuit protection by means of a thermal magnetic element. Compensation shall be accomplished by a secondary bimetal that will allow the breaker to carry rated current between 25oC. and 50oC. with tripping characteristics that are approximately the same throughout this temperature range.

H. For breakers with interchangeable, thermal, adjustable magnetic trip, the accessibility and position of the adjustment knob shall not be changed from those on the standard breaker or as listed in the circuit breaker setting schedule on the drawing.

I. Circuit breakers shall be molded case type equal to those manufactured by Square D, Cutler-Hammer or Siemens and shall be of the same manufacturer as the panelboards.

J. Circuit breakers noted on drawings are specifically designed for coordination purposes. Any deviation from the specified breakers will require the Contractor to submit an engineered coordination study to prove the ability of any substituted breakers to coordinate as designed. This study must be stamped and signed by a licensed professional engineer.

2.14 MOTOR STARTERS:

A. Electrical Contractor shall install all starters furnished under Division 15, Mechanical, and provide all wiring from the power source, thru the starter to the motor. A separately mounted

safety disconnect switch shall be provided, except where the panelboard containing disconnect and circuit protection for the motor is fully visible from, and not over 50 feet from, the starter locations.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Contractor shall verify all door swings before installing light switches.

B. Branch circuits of similar single-phase circuits may be combined on one conduit with a common neutral (Exception: GFI circuit). Only three single-phase circuits shall be installed in any conduit.

C. Provide and install all devices, material, and hardware as required for a complete installation.

D. Before installation, all devices shall be coordinated with all associated trades.

E. All starters shall be located where fully visible from and not more than 50 feet from the motor location. If it is not possible to see the starter from the motor location shown, obtain a new location from the engineers or provide a starter capable of being locked open.

F. Prior to final inspection, the Electrical Contractor shall check all devices and equipment installed by him, for damages during construction and replacing where necessary. All devices shall be cleaned and left in complete operable condition at time of final acceptance of the building.

G. Connections to Equipment:
1. Mechanical Equipment: The Electrical Subcontractor shall make final electrical connections to all items of equipment furnished by the Mechanical Subcontractor.

H. Conductors for feeders shall be sized to prevent a voltage drop exceeding 3 percent at its furthest point. Combination of feeders and branch circuits shall be sized to prevent a maximum voltage drop of 5 percent at circuit’s furthest point from point of origin. Temperature conditions to which conductors are subject shall be additionally compensated for.

I. "IMPORTANT” Contractor shall permanently mark with "permanent" black magic marker, circuit numbers and panel designation "IN" bottom of outlet boxes (both lighting and receptacles) and "in" safety switches.

J. Panelboards located in spaces subject to storage shall have the clear working space per NFPA-70, National Electric Code. "Electrical Access - Not For Storage" shall be permanently marked on the floor and wall about the panel. This shall be coordinated with the Architect.

END OF SECTION 16100